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Virus Diseases of Leafy Vegetables and Celery

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Lettuce, endive (escarole), spinach, and celery are members of different plant families, but share many of the same viral problems. In New York most of these crops are produced on organic soils, but they may also be grown on mineral soils. Because these crops are often planted near one another, the viruses or other agents infecting the crops are the same, and they are transmitted by the same insect vectors.

The viruses infecting lettuce or endive include lettuce mosaic virus (LMV), cucumber mosaic virus (CMV), turnip mosaic virus (TuMV), broadbean wilt virus (BBWV), Bidens mottle virus (BiMV), and beet western yellows virus (BWYV). Additional organisms infecting lettuce are lettuce big vein agent (LBVA) and aster yellows mycoplasma (AY).

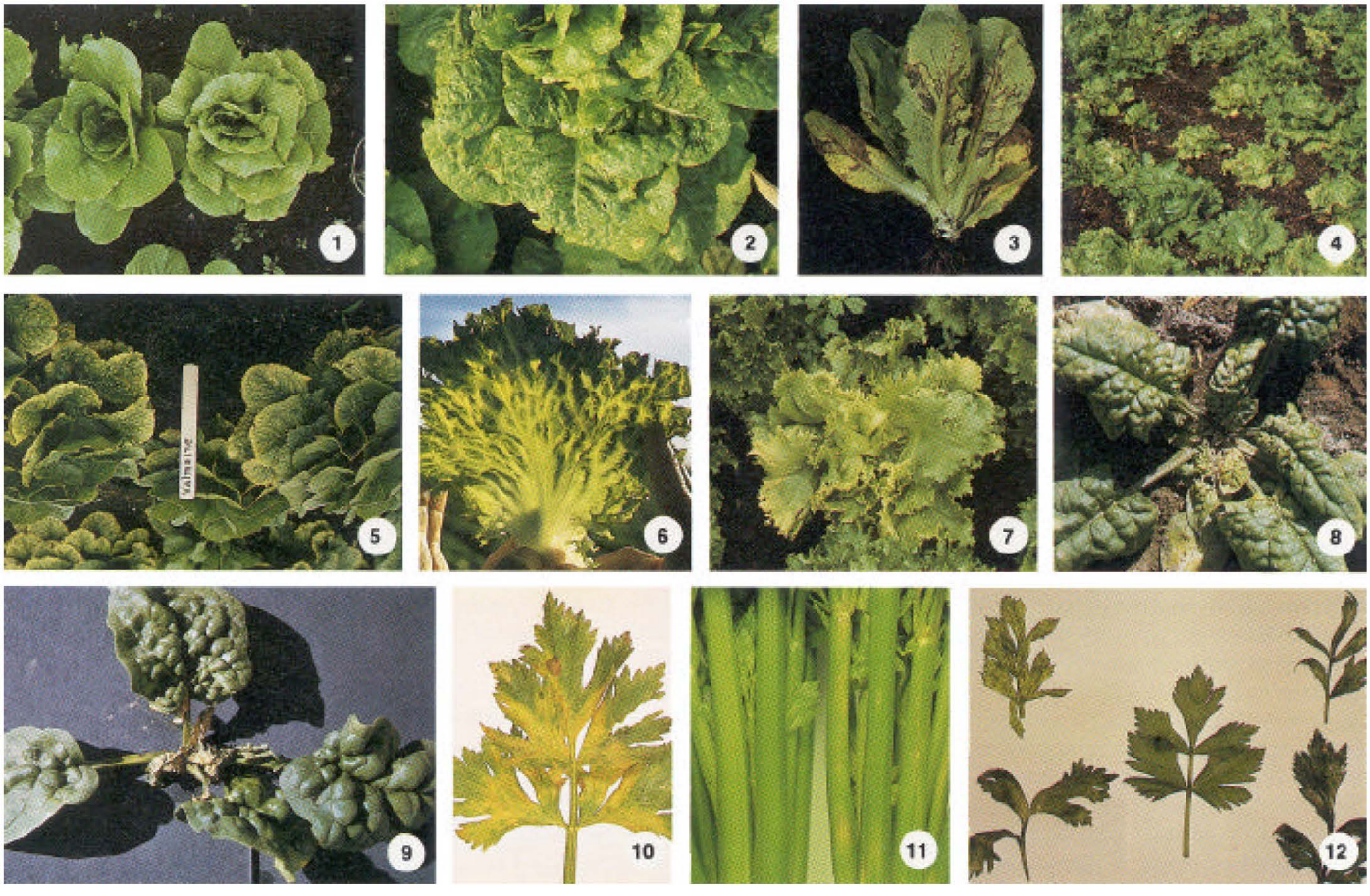
The viruses infecting spinach in New York include LMV, CMV, BBWV, and TuMV.

The two most important virus diseases of celery are CMV and celery mosaic virus (CeMV); the occurence of aster yellows mycoplasma (AY) depends upon the prevalence of the leafhopper vector.

Lettuce and Endive Diseases

Lettuce mosaic virus (LMV) can infect all lettuce types (crisphead, cos, Boston, bibb, and leaf) as well as escarole and endive. LMV is seedborne in all lettuce types, but not in endive; and infected seed probably serves as the chief source of inoculum, although weed hosts are also recognized.

Plants infected through seed are referred to as seedborne "mother" plants because they can serve as virus reservoirs from which aphids can spread the virus to surrounding healthy plants. The mother plants show early mosaic symptoms, are stunted, and never develop



marketable heads. Secondary infected plants show mosaic, leaf puckering, and deep or accentuated serration of the leaf margins in most lettuce types (fig. 1). Endive heads may be stunted, but generally show only mild mosaic symptoms.

Two methods for controlling LMV are currently in use. First, because of the prevalence of seedborne virus, lettuce seed is tested by three methods (direct reading of lettuce seedlings, inoculation of ground-up seed with a sensitive indexing host, or, more recently, a serological technique) to ensure that each lettuce seed lot contains no infected seeds in a sample of 30,000 seeds (MTO or mosaic tolerance zero). A more successful control measure is the incorporation of virus resistance into the principal lettuce types grown on both mineral and organic soils.

Cucumber mosaic virus (CMV) is the most important virus disease of lettuce in New York and the most difficult to control. Because the virus can infect more than 775 plant species, including many weed species (chickweed, milkweed, purslane, dayflower, etc.), many reservoirs exist to overwinter the virus near growers' fields. Winged aphids transmit the virus from bordering weedy areas to the crop to create primary infection sites. Secondary infections account for most virus spread and occur when migrant aphids spread the virus from infected primary lettuce plants to surrounding healthy plants. When large migrant-aphid flights occur, an entire field may become almost totally infected in a matter of weeks.

Although the symptoms of CMV bear some resemblance to those of LMV, the mosaic is more intense with veinal chlorosis and, frequently, veinal browning and necrosis when temperatures in the mid-50s or lower occur (fig. 2).

Because weed hosts harboring CMV are common, a concerted effort must be made by adjoining lettuce growers to make weed sanitation and other programs effective. Weed control must be done before or soon after the crop is planted. Because migrant aphids account for much of the virus spread and, normally, do not colonize lettuce, insecticidal sprays are only minimally effective in reducing spread. Reducing primary inoculum in the crop is so critical in delaying virus epidemics that major emphasis should be applied at this point. Make earliest plantings downwind from weedy border areas, so that older lettuce plantings do not serve as reservoirs of virus for subsequently planted crops. Although not extensively tested on lettuce, mineral oil sprays are known to significantly reduce secondary virus spread in many nonpersistent, aphid-transmitted virus diseases such as CMV, provided the treatment is begun before primary inoculum exceeds 8–10% and heavy virus pressure is not present in adjoining fields. Spraying border areas with mineral oils is also beneficial. The technique used is sophisticated; consult extension personnel for complete details.

Because of the existence of several strains of CMV in New York, breeding of resistant lettuce varieties has been slowed, but is continuing.

Turnip mosaic virus (TuMV) is not a common disease of lettuce varieties, but escarole and endive are very susceptible. Susceptibility to TuMV was inadvertently transferred to some lettuce varieties by breeding for resistance to downy mildew. TuMV typically causes veinal chlorosis and necrosis of lower leaves of both lettuce (fig. 3) and endive, severely stunting the plants and making the heads unmarketable.

Cruciferous weed hosts (shepherdspurse, etc.) are the principal source of inoculum for this aphid-transmitted virus, and controls discussed under CMV are applicable.

Broadbean wilt virus (BBWV), like CMV, can cause a serious disease of lettuce in susceptible varieties, resulting in large patches of infected plants (fig. 4). Symptoms are similar to those of LMV and CMV, but with low field temperatures the infected plants develop severe veinal necrosis. Some varieties are very susceptible whereas others display good tolerance to infection.

BBWV is transmitted by aphids in a nonpersistent manner. The major weed hosts in New York have been identified as broadleaf plantain *(Plantago major)* and buckhorn plantain *(P. lanceolata).*

Bidens mottle virus (BiMV) has been recovered from lettuce and endive in Orange County, but is not widely distributed in the state. Symptoms caused by BiMV are similar to those of LMV in both lettuce and endive. The lettuce variety Valmaine (a romaine or cos type) is naturally resistant to BiMV and has been used in breeding programs for joint resistance to BiMV and LMV.

BiMV is not seedborne in either lettuce or endive, and principal weed hosts for this aphid-transmitted virus are beggarticks, pepperweed, and others.

Beet western yellows virus (BWYV) is an important virus disease of lettuce and endive in California, Arizona, and Florida. Although not formally recognized in this state, weed hosts such as shepherdspurse are present. BWYV causes a pronounced chlorosis of the outer leaves of lettuce (fig. 5) and escarole.

Although spread by many of the same aphid species that are vectors for the other common lettuce viruses, BWYV is transmitted in a persistent manner, meaning that a longer time is required to acquire and then transmit the virus. Insecticidal sprays would presumably help to delay the spread of this particular virus disease.

Lettuce big vein agent (LBVA) is probably caused by a virus, although the virus particle has not been seen with the electron microscope. This disease differs greatly from the other lettuce virus diseases; its vector in nature is a soilborne fungus *(Olpidium brassicae).* The virus is acquired by the fungus protoplast in virus-infected roots and is carried by fungal zoospores, which infect healthy roots and release the virus.

Infected lettuce plants are striking, with leaves showing enlarged and lightened veins and petioles (fig. 6). Leaves are also thickened and distorted, and heads are smaller than normal.

Because of the soilborne nature of the disease, no practical control measures are available.

Aster yellows mycoplasma (AY), formerly thought to be caused by a virus, can infect a wide range of plants in addition to lettuce and celery. The disease results in strikingly yellowed and stunted plants (fig. 7), which are unmarketable. This disease may occur annually, its extent being determined by the preponderance of the aster leafhopper vector *(Macrosteles fascifrons).* Controls are based upon the use of insecticidal sprays to reduce the only known vector.

Virus Diseases of Spinach

Cucumber mosaic virus (CMV) infection of spinach has long been called "spinach blight" by growers, but should not be confused with fungal diseases for which the term *blight* is more commonly used. The disease is caused by CMV, which is covered in detail in other sections of this fact sheet. Infected spinach plants may show a variety of symptoms including stunting, yellowing, and mottling of the older leaves and malformation of the younger leaves. Good resistance to CMV is available, but this resistance is temperature dependent; at temperatures above 80° F crown necrosis will develop (fig. 8),

which is similar to infection with broad bean wilt virus (BBWV) without the need for high temperatures (fig. 9). With the exception of the high temperature response for CMV infection, resistance for CMV in spinach has provided an effective control measure for over 60 years.

Broadbean wilt virus (BBWV) has previously been mentioned in this report. This virus does cause a major disease of spinach, particularly in the autumn crop when aphid vectors are most plentiful and much inoculum is present from earlier plantings.

Symptoms of BBWV closely resemble those caused by CMV, and therefore, identification is impossible under field conditions (fig. 9).

Control involves the removal of the principal weed hosts *P. major* and *P. lanceolata.* Mineral oil sprays to delay virus spread have been used only on a trial basis and have not been tested under heavy disease pressure.

Lettuce mosaic and turnip mosaic viruses (LMV and TuMV), in addition to infecting lettuce, can also infect spinach. Neither LMV nor TuMV is seedborne in spinach, but an adjoining lettuce crop could inadvertently lead to infection of spinach. LMV symptoms on spinach consist of bright yellow circular spots that coalesce into a diffuse dull chlorotic mottle. Young infected leaves are small, mottled, and distorted. Older plants are stunted, and old infected leaves die prematurely. TuMV-infected plants show diffuse mottle, leaf distortion, and stunting. Lower leaves become necrotic and abscise prematurely.

Celery Diseases

Cucumber mosaic virus (CMV), also called southern celery mosaic, is the principal virus disease of celery in New York. The chief characteristics of this virus disease and control measures have already been discussed.

CMV symptoms consist of general mosaic, which, on older leaves infected earlier, develops into chlorotic yellowing and veinal necrosis (fig. 10). Plants infected when young will also be stunted. The petioles on similarly infected plants may also show slightly sunken, buff-colored lesions (fig. 11). If plants are infected at an early age, inner petioles are also affected, making the plant unmarketable.

Celery mosaic virus (CeMV), also called western celery mosaic because it was first identified in California, can also be a serious disease of celery. The virus is transmitted by several aphid species in a nonpersistent manner and is limited only to umbelliferous plants (celery, carrot, parsley, etc.). Plants infected at an early age are greatly stunted, and the foliage, after showing early mosaic, becomes cupped and malformed (fig. 12). Because of the limited host range, destruction of umbelliferous weeds is the recommended control measure.

Aster yellows mycoplasma (AY) may also infect celery on an annual basis. This disease is described under "Lettuce and Endive Diseases."

Quantity discount available.

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